Claims

What is claimed is:

1. A catheter system for delivering indomethacin to a selected site within a hippocampus or lateral ventricle, comprising:

a pump;

a source of indomethacin in fluid communication with the pump; and

a catheter coupled to the pump, the catheter having a distal and a proximal end, the catheter having a first tubular portion and a second tubular portion, the first tubular portion being made from a relatively impermeable material and having a first tubular portion lumen, the first tubular portion having a proximal and a distal end, the second tubular portion having a second tubular portion lumen and an open end and a closed end, the open end disposed within the first tubular portion lumen at the distal end of the first tubular portion, the second tubular portion having a closed end disposed distally of the distal end of the first tubular portion, the second tubular portion being made of a porous material having a preselected microporosity that permits indomethacin to flow through the second tubular portion lumen and out of the catheter through the second tubular portion into the hippocampus or lateral ventricle.

2. The system of claim 1 wherein the second tubular portion is selectively moveable with respect to the first tubular portion.

3. The system of claim 1 wherein the pump is adapted for subcutaneous placement.

4. The system of claim 1 wherein the porous material of the second tubular portion has a microporosity of less than or equal to 0.22 microns.

5. The system of claim 4 wherein the porous material of the second tubular portion is selected from the group of materials consisting of polyamide, polyethylene, polypropylene and hollow fiber polysulfone.

6. The system of claim 1 wherein the impermeable material of the first tubular portion is selected from the group of materials consisting of polyurethane, silicone and polyacrylonitrile.

7. The system of claim 1 wherein the impermeable material of the first tubular portion expands when exposed to a preselected solvent so that the internal diameter of the first tubular portion increases from a first internal diameter to a second internal diameter whereby the second tubular portion may be moved relative to the first tubular portion after the first tubular portion has been exposed to the preselected solvent and wherein the first tubular portion contracts when the solvent is removed from contact with the first tubular portion so that the first tubular portion returns to the first internal diameter.

8. The system of claim 1 wherein the impermeable material of the first tubular portion expands when heated so that the internal diameter of the first tubular portion increases from a first internal diameter to a second internal diameter whereby the second tubular portion may be moved relative to the first tubular portion after the first tubular portion has been exposed to heat and wherein the first tubular portion contracts when the first tubular portion is removed from contact with heat so that the first tubular portion returns to the first internal diameter.

9. The system of claim 1 wherein a portion of the distal end of the second tubular portion contains a radiographic marker.

10. The system of claim 1 wherein a portion of the distal end of the second tubular portion contains a nuclear magnetic resonance marker.

11. A catheter system for delivering a nonsteroidal anti-inflammatory agent having cyclooxygenase inhibitor action to a selected site within a hippocampus or lateral ventricle, comprising:

a pump;

a source of nonsteroidal anti-inflammatory agent having cyclooxygenase inhibitor action in fluid communication with the pump; and

a catheter coupled to the pump, the catheter having a distal and a proximal end, the catheter having a first tubular portion and a second tubular portion, the first tubular portion being made from a relatively impermeable material and having a first tubular portion lumen, the first tubular portion having a proximal and a distal end, the second tubular portion having a second tubular portion lumen and an open end and a closed end, the open end disposed within the first tubular portion lumen at the distal end of the first tubular portion, the second tubular portion having a closed end disposed distally of the distal end of the first tubular portion, the second tubular portion being made of a porous material having a preselected microporosity that permits nonsteroidal anti-inflammatory agent having cyclooxygenase inhibitor action to flow through the second tubular portion lumen and out of the catheter through the second tubular portion into the hippocampus or lateral ventricle.

12. A catheter for conveying indomethacin into an hippocampus or lateral ventricle, the catheter having a distal and a proximal end, the catheter comprising:

a) a first tubular portion made from a relatively impermeable material, the first tubular portion having a first tubular portion lumen;

b) a second tubular portion having an open end disposed within the distal end of the first tubular portion lumen and a closed end disposed distally of the distal end of the first tubular portion lumen, the second tubular portion being made of a porous material having a preselected microporosity;

whereby indomethacin flows through the first tubular portion lumen and out of the catheter through the second tubular portion into the hippocampus or lateral ventricle.

13. The catheter of claim 12 wherein the porous material has a microporosity of less than or equal to 0.22 microns.

14. The catheter of claim 12 wherein the porous material is selected from the group of materials consisting of polyamide, polyethylene, polypropylene and hollow fiber polysulfone.

15. The catheter of claim 12 wherein the impermeable material of the first tubular portion is selected from the group of materials consisting of polyurethane, silicone and polyacrylonitrile.

16. The system of claim 12 wherein the impermeable material of the first tubular portion expands when exposed to a preselected solvent so that the internal diameter of the first tubular portion increases from a first internal diameter to a second internal diameter whereby the second tubular portion may be moved relative to the first tubular portion after the first tubular portion has been exposed to the preselected solvent and wherein the first tubular portion contracts when the solvent is removed from contact with the first tubular portion so that the first tubular portion returns to the first internal diameter.

17. The system of claim 12 wherein the impermeable material of the first tubular portion expands when heated so that the internal diameter of the first tubular portion increases from a first internal diameter to a second internal diameter whereby the second tubular portion may be moved relative to the first tubular portion after the first tubular portion has been exposed to heat and wherein the first tubular portion contracts when the first tubular portion is removed from contact with heat so that the first tubular portion returns to the first internal diameter.

18. The catheter of claim 12 wherein a portion of the distal end of the second tubular portion contains a radiographic marker.

19. The catheter of claim 12 wherein a portion of the distal end of the second tubular portion contains a nuclear magnetic resonance marker.

20. A catheter for conveying nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action into an hippocampus or lateral ventricle, the catheter having a distal and a proximal end, the catheter comprising:

a) a first tubular portion made from a relatively impermeable material, the first tubular portion having a first tubular portion lumen;

b) a second tubular portion having an open end disposed within the distal end of the first tubular portion lumen and a closed end disposed distally of the distal end of the first tubular portion lumen, the second tubular portion being made of a porous material having a preselected microporosity;

whereby nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action flows through the first tubular portion lumen and out of the catheter through the second tubular portion into the hippocampus or lateral ventricle.

21. A catheter comprising:

an elongated tubular portion having a tubular portion lumen, a proximal end and a distal end, the tubular portion terminating at the most distal end in a tip wherein the tubular portion expands in diameter in response to an external stimulus.

22. The catheter of claim 21 wherein the tubular portion is composed of a relatively impermeable material.

23. The catheter of claim 22 wherein the relatively impermeable material of the tubular portion is polyacrylonitrile.

24. The catheter of claim 21 wherein the tubular portion is composed of a tear resistant material.

25. The catheter of claim 24 wherein the tear resistant material is chosen from the group consisting of silicone elastomer and polyurethane.

26. The catheter of claim 21 wherein the tubular portion is made of a biocompatible material.

27. The catheter of claim 21 wherein the tip is rounded to minimize tissue disruption during insertion.

28. The catheter of claim 21 wherein the tubular portion has an externally tapered distal end surface to minimize tissue disruption during insertion.

29. The catheter of claim 21 wherein the tip has a generally tubular shape and fits snugly within the tubular portion lumen.

30. The catheter of claim 21 wherein the tip has a tip lumen aligned with and in fluid communication with the tubular portion lumen.

31. The catheter of claim 21 wherein the diameter of the tubular portion lumen and the external diameter of tip are the same.

32. The catheter of claim 21 wherein the tip is composed in part of a porous material chosen from the group consisting of polysulfone, polyethylene, polyamide, polypropylene and expanded polytetrafluoroethylene (ePTFE).

33. The catheter of claim 32 wherein the porous material of the tip extends along the entire length of the tip.

34. The catheter of claim 32 wherein the pore size of the porous material of the tip is approximately between 0.1-0.2 microns.

35. The catheter of claim 21 wherein the tip has at least one elution hole extending therethrough in fluid communication with the tubular portion lumen.

36. The catheter of claim 21 wherein the tubular portion is made of a relatively impermeable material such as polyacrylonitrile, polyethylene, polypropylene, or silicone elastomer.

37. The catheter of claim 21 further comprising means for locating the distal end of the catheter during a process of positioning the catheter.

38. The catheter of claim 37 wherein the means for locating is a radiopaque marker located on the distal end of the catheter.

39. The catheter of claim 38 wherein the marker comprises tantalum powder dispersed in a matrix of a biocompatible adhesive.

40. The catheter of claim 38 wherein the marker comprises barium powder dispersed in a matrix of a biocompatible adhesive.

41. The catheter of claim 38 wherein the marker comprises platinum powder dispersed in a matrix of a biocompatible adhesive.

42. The catheter of claim 38 wherein the marker comprises a semispherical portion having a cylindrical nipple emanating away from the semispherical portion.

43. A method of delivering indomethacin to a selected site within a hippocampus or latereral ventricle comprising the steps of:

a) providing a catheter having a first tubular portion that has a first tubular portion lumen and a second tubular portion partially disposed within the first tubular portion lumen;

b) adjusting the length of the second tubular portion extending from the first tubular portion lumen to conform to the dimensions of a selected site in an hippocampus or lateral ventricle;

c) placing the catheter in the hippocampus or lateral ventricle so that the second tubular portion is placed at the selected site in the hippocampus or lateral ventricle;

d) providing a source of indomethacin;

e) coupling the catheter and the source of indomethacin to a pump for delivering indomethacin from the source of indomethacin to the hippocampus through the catheter; and

f) actuating the pump to deliver the indomethacin to the hippocampus or lateral ventricle.

44. The method of claim 43 wherein the step of providing a catheter having a first tubular portion that has a first tubular portion lumen includes the step of:

a) making the first tubular portion of a material that increases in diameter when heated; and,

wherein the step of adjusting the length of the second tubular portion includes the steps of:

1) heating the first tubular portion until the diameter of the first tubular portion lumen increases in diameter a sufficient amount to enable relative sliding movement between the first tubular portion and the second tubular portion;

2) sliding the second tubular portion in the first tubular portion lumen relative to the first tubular portion to provide a preselected length of the second tubular portion extending beyond the end of the first tubular portion; and

3) cooling the first tubular portion until the first tubular portion and the second tubular portion are no longer capable of relative sliding movement.

45. The method of claim 43 wherein the step of providing a catheter having a first tubular portion that has a first tubular portion lumen includes the step of:

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a) making the first tubular portion of a material that increases in diameter when exposed to a solvent; and,

wherein the step of adjusting the length of the second tubular portion includes the steps of:

1) exposing the first tubular portion to a solvent that increases the diameter of the first tubular portion lumen a sufficient amount to permit relative sliding movement of the second tubular portion in the first tubular portion lumen;

2) sliding the second tubular portion in the first tubular portion lumen to obtain a preselected length of the second tubular portion extending distally beyond the distal end of the first tubular portion; and

3) ceasing to expose the first tubular portion to the solvent whereby the diameter of the first tubular portion lumen decreases until relative sliding movement between the first tubular portion and the second tubular portion is prevented.

46. A method of delivering nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action to a selected site within a hippocampus or latereral ventricle comprising the steps of:

a) providing a catheter having a first tubular portion that has a first tubular portion lumen and a second tubular portion partially disposed within the first tubular portion lumen;

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b) adjusting the length of the second tubular portion extending from the first tubular portion lumen to conform to the dimensions of a selected site in an hippocampus or lateral ventricle;

c) placing the catheter in the hippocampus or lateral ventricle so that the second tubular portion is placed at the selected site in the hippocampus or lateral ventricle;

d) providing a source of nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action;

e) coupling the catheter and the source of nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action to a pump for delivering nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action from the source of nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action to the hippocampus through the catheter; and

f) actuating the pump to deliver the nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action to the hippocampus or lateral ventricle.

47. A method of making a catheter comprising the steps of:

providing a tubular body made of a tear resistant material that expands in the presence of a select external stimulus, the tubular body having a tubular body lumen with a diameter;

exposing the tubular body to the external stimulus that causes the material of the tubular body to expand whereby the tubular body expands;

placing a tip in the tubular body lumen, the tip having an outside diameter at least equal to the inside diameter of the tubular body lumen when the tubular body is not exposed to the select external stimulus;

moving the tip relative to the tubular body to achieve a desired configuration between the tip and the tubular body; and,

halting the exposure of the select external stimulus to the tubular body whereby the tubular body returns to its original size.

48. The method of claim 47 wherein the material that expands in the presence of a select external stimulus is chosen from the group consisting of silicone elastomer or polyurethane.

49. The method of claim 47 wherein the step of providing a tubular body includes the step of making the tubular body of a material that increases in diameter when heated;

wherein the step of placing a tip in the tubular body lumen includes the step of heating the tubular body until the diameter of the tubular body lumen increases in diameter a sufficient amount to enable relative sliding movement between the tubular body and the tip as the tip is placed in the tubular body lumen; and, wherein the step of halting the exposure of the select external stimulus to the tubular body includes the step of cooling the tubular body until the tubular body and the tip are no longer capable of relative sliding movement.

50. The method of claim 47 wherein the step of providing a tubular body includes the step of making the tubular body of a material that increases in diameter when exposed to a solvent; wherein the step of placing a tip in the tubular body lumen includes the step of exposing the tubular body to the solvent until the diameter of the tubular body lumen increases in diameter a sufficient amount to enable relative sliding movement between the tubular body and the tip as the tip is placed in the tubular body lumen; and, wherein the step of halting the exposure of the select external stimulus to the tubular body includes the halting the exposure of the tubular body to the solvent until the tubular body and the tip are no longer capable of relative sliding movement.

51. The method of claim 47 wherein the step of exposing the tubular body to the external stimulus includes the step of exposing the tubular body to a solvent.

52. The method of claim 51 wherein the step of halting the exposure of the select external stimulus to the tubular body includes evaporating the solvent.

53. The method of claim 47 further comprising the steps of:

providing a connecting catheter for connecting the proximal end of the catheter to a source of indomethacin.

54. The method of claim 47 further comprising the steps of:

providing a connecting catheter for connecting the proximal end of the catheter to a source of nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action.

55. A method of manufacturing a catheter comprising the steps of:

a) forming a first tubular portion of a relatively impermeable material, the first tubular portion formed having a lumen with a diameter;

b) forming second tubular portion of a porous material;

c) partially disposing the second tubular portion within the lumen;

d) adjusting the length of the second tubular portion to conform to the dimensions of a selected site in an hippocampus or lateral ventricle; and

e) establishing a near zero tolerance fit between the overlap of the second tubular portion and the first tubular portion.

56. The method of claim 55 wherein the step of forming a first tubular portion of a relatively impermeable material includes the step of forming the first tubular portion of a material that increases in the diameter of the lumen when the first tubular portion is heated; and, wherein the step of adjusting the length of the second tubular portion comprises the steps of:

a) heating the first tubular portion until the diameter of the lumen increases in diameter a sufficient amount to enable relative sliding movement between the first tubular portion and the second tubular portion;

b) sliding the second tubular portion in the lumen relative to the first tubular portion to provide a preselected length of the second tubular portion that extending distally beyond the distal end of the first tubular portion; and

c) cooling the first tubular portion until the first tubular portion and the second tubular portion are no longer capable of relative sliding movement.

57. The method of claim 55 wherein the step of forming a first tubular portion of a relatively impermeable material includes the step of forming the first tubular portion of a

material that increases in the diameter of the lumen when the first tubular portion is exposed to a solvent; and, wherein the step of adjusting the length of the second tubular portion comprises the steps of:

a) exposing the first tubular portion to a solvent that increases the diameter of the lumen a sufficient amount to permit relative sliding movement of the second tubular portion in the lumen;

b) sliding the second tubular portion in the lumen to obtain a preselected length of the second tubular portion extending distally beyond the distal end of the first tubular portion; and

c) ceasing to expose the first tubular portion to the solvent whereby the diameter of the first tubular portion decreases until relative sliding movement between the first tubular portion and the second tubular portion is prevented.

58. A method of treating Alzheimer's disease comprising the steps of:

implanting the distal end of a catheter having a distal end and a proximal end in a patient's hippocampus or lateral ventricle;

attaching the proximal end of the catheter to a source of indomethacin;

infusing indomethacin through the catheter to exit the distal end of the catheter in the patient's hippocampus or lateral ventricle.

59. The method of claim 58 wherein the step of implanting the distal end of a catheter includes the step of accessing the hippocampus through a posterior occipital lobe.

60. The method of claim 58 wherein the step of implanting the distal end of a catheter includes the step of anteriorally accessing the lateral ventricle through the frontal lobe.

61. The method of claim 58 wherein the step of implanting the distal end of a catheter includes the step of posteriorally accessing the lateral ventricle through the occipital lobe.

62. The method of claim 58 wherein the step of implanting includes the steps of:

introducing a trocar into the patient's hippocampus or lateral ventricle;

passing the catheter through the trocar so that the distal end of the catheter leaves the trocar and enters the hippocampus or lateral ventricle;

removing the trocar leaving the catheter in place.

63. The method of claim 58 wherein the step of implanting includes the step of:

introducing a catheter containing a stylet through a selected lobe to the patient's hippocampus or lateral ventricle;

removing the stylet leaving the catheter in place.

64. A method of treating Alzheimer's disease comprising the steps of:

implanting the distal end of a catheter having a distal end and a proximal end in a patient's hippocampus or lateral ventricle;

attaching the proximal end of the catheter to a source of nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action;

infusing nonsteroidal anti-inflammatory agents having cyclooxygenase inhibitor action through the catheter to exit the distal end of the catheter in the patient's hippocampus or lateral ventricle.

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